Topaz II Proves To Be Gem For International Tech Transfer

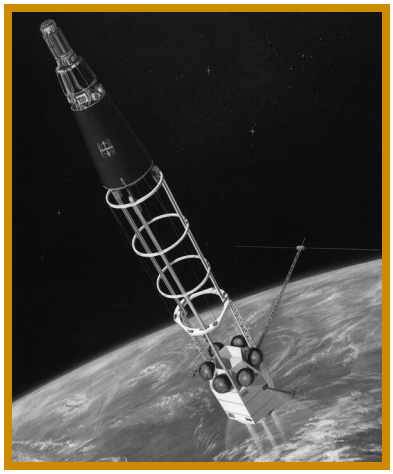
A decade ago, many people thought their grandchildren would never live to see the day when former Soviet Union (FSU) and American researchers would do business together—especially in the defense technology area. But once the Iron Curtain came down, paradigms began to shift. U.S. researchers became interested in innovations that Russian scientists had developed, and many Russian scientists wanted to apply their government-funded research to commercial uses.

The first program to successfully shape these types of collaborations in defense technology was the Topaz International Program, funded by BMDO. Six thermionic reactors and the testing facilities for space vehicles were purchased, and technology innovations, especially in the materials area, began to flow into the United States. The FSU, in turn, was able to obtain much-needed capital for its institutes and receive an education in commercializing government-funded R&D.

BMDO'S TOPAZ II PROGRAM HAS CREATED MODELS FOR FUTURE BUSINESS DEALS BETWEEN THE UNITED STATES AND THE FORMER SOVIET UNION.

The nations have broken through the bureaucracies and cultural barriers, and learned about each other's business practices, creating new business models that have allowed further cooperation and business deals. In addition, BMDO has saved hundreds of millions of dollars by spinning in existing Russian technology rather than "reinventing the wheel."

BMDO purchased the reactors through a U.S. small business called International Scientific Products, or ISP (San Jose, CA), an affiliate of Space Power, Inc. (same location). This company heads the marketing efforts for a Russian limited-liability joint stock corporation called INERTEK, which was formed around the Topaz II purchase. INERTEK also includes participants from four Topaz II-involved institutes.



Pursuing power solutions for space-based missions, BMDO obtained thermionic reactors originally developed by the former Soviet Union.

The Topaz II acquisition was so successful that a coalition called the United States Industry Coalition (USIC) was formed, adopting many of the lessons learned from the Topaz experience. USIC has now funded roughly 80 collaborations between U.S. Government and industry and the FSU.

Components of the reactor have been cited for several applications. For example, some of the unique materials used for the reactor have grabbed the interest of a major U.S. utility, which is now collaborating with the FSU to increase the lifetime of gas turbine blades. These materials include single-crystal refractory metals and single-crystal ceramics, as well as techniques to bond metal seals to ceramic. Motorola has been investigating Topaz II shipping containers for its IRIDIUM™/℠ satellite communications program. Developed for transporting complete Topaz II systems to the United States via aircraft, these large stainless steel shipping containers have thermal control and inert gas capabilities.

In addition, the turbomolecular vacuum pump used on the Topaz II test stand can address environmental and manufacturing needs. Able to remove 10,000 liters of material per second, it works like a jet engine in reverse. In a matter of hours this high performance pump can complete a job that would take a competing diffusion pump 2 weeks. The National Center for Manufacturing Sciences has identified 21 other areas where Topaz II technology can be used.

The INERTEK participating institutes (and others) are using working capital from the sale of the reactors to develop non-Topaz-related products, such as spray-on skin for burn victims. A major U.S. health product corporation has shown considerable interest in this topically applied material. The material, which looks and feels like skin, can be sprayed on burns and abrasions, replacing conventional bandages. The institutes also have developed two classes of ozone-friendly refrigerants that do not harm refrigerator parts. Western ozone-friendly refrigerant has typically been incompatible with existing lubricants and sometimes corrodes other refrigerator parts. The refrigerants are undergoing tests for safety and reliability, and will probably be marketed by ISP.

Also, as a result of the formation of INERTEK and stimulated by the Topaz II purchase, a U.S. company is now working with the Russians to build a facility in the FSU that produces cheaper and better boron. In addition to its use in nuclear reactors, boron is essential to manufacture semiconductors and may be valuable in treating cancer patients. Enriched ^{10}B now costs about $3 per gram, but this facility could reduce the cost by two-thirds.

The first of the cargo jets delivering the TOPAZ II thermionic reactors arrived at Kirkland Air Force Base on May 7, 1992.

Who were the players in Topaz II? The initial Topaz reactor was delivered to a consortium of Federal and private organizations including ISP, the Air Force Phillips Laboratory, Sandia National Laboratories, New Mexico Engineering Research Institute (all in Albuquerque, NM), the U.S. Department of Energy, Los Alamos National Laboratory (Los Alamos, NM), and Johns Hopkins University (Laurel, MD). The program also used specialists from the United Kingdom and France. FSU participants were headed by the Kurchatov Institute (Moscow). Other participating FSU institutes include the Central Design Bureau of Machine Building (St. Petersburg), the Scientific Industrial Association "Luch" (Podolsk), and the Scientific Research Institute of Thermal Processes (Moscow). The program currently resides at the Defense Nuclear Agency.

About The Technology

High-tech satellites and space vehicles with long missions are expected to require more power than solar cells can provide. Therefore, BMDO pursued other power solutions, such as space-based nuclear-powered generators. In fact, along with NASA's Jet Propulsion Laboratory and the U.S. Department of Energy, BMDO conducted R&D on some nuclear power space technology in a project called the SP-100 program; however, no near-term, space-qualified solutions were found.

The FSU's institutes (similar to Federal laboratories) successfully developed space-based electric generators, called thermionic reactors, which directly convert heat into electrical energy using nuclear fuel. These reactors are called Topaz II. A version of Topaz, called Topaz I, was used successfully on two FSU satellites.

Negotiations began in 1990, and the Topaz II reactors were delivered to the New Mexico Engineering Research Institute in May 1992. The reactors were then tested using tungsten heaters rather than nuclear fuel. The cost of the initial purchase and test stand assemblies was $13 million.

The innovative testing facilities cost $1 million, while another U.S. space-based nuclear reactor project estimated testing would have cost about $150 million. These large savings are largely due to the group's ability to evaluate the Topaz II power systems using surrogate, electrical tungsten heaters, avoiding the use of nuclear materials.

Design studies for a 40-peak kilowatt (kWe) high-power system have been performed. Under contract with the U.S. Department of Energy, ISP and its sister company, Space Power, Inc., are incorporating Topaz II technology into their SPACE-R reactor concept. The 40-kWe SPACE-R system is expected to weigh less than half and be less than one-tenth the size of an equivalent solar cell system, which typically supplies power levels of about 5 to 6 kWe.